
SAMISH BASIN: KEEPING SHELLFISH BEDS OPEN

The Samish Bay Watershed contains approximately 140 square miles of land covered in lowland farms, fields, and timber in a largely rural community. Samish Bay contains both commercial and recreational shellfish harvesting areas. The shellfish harvest in Samish Bay is worth approximately \$3 million a year in sales alone. Since 2011, 52 shellfish harvesting area closures have been implemented due to high levels of fecal coliform bacteria, an indicator of fecal pollution from warm-blooded animals that could be associated with pathogens.

In 2008, large values of fecal contamination discovered after storms intensified management responses by local agencies to reduce sources of fecal bacteria. Tremendous effort from local government entities has since been initiated to address the status of Samish Bay, identify the causes of fecal contamination, and improve water quality to support viable, long-term aquaculture. The Clean Samish Initiative was developed to implement and monitor the Total Maximum Daily Load (TMDL) which was established by the Department of Ecology in 2007. In 2011, about 4,000 acres of the Samish Bay shellfish growing area were downgraded due to high bacteria levels in the Samish River. Subsequently, Skagit County and a number of federal and state agencies and organizations have developed a concerted effort to identify fecal contamination sources, restore water quality, and improve community outreach.

Watershed activities in the area that may contribute to fecal loading in the Samish River and Bay include residential sewage and septic systems, beef and dairy cattle farms, crop land, and non-commercial agriculture. Sources of fecal contamination in the watershed include failing on-site sewage systems, manure application, livestock, non-point source run-off, inadequate stream buffers, pet waste, and wildlife. The Clean Samish Initiative, in conjunction with an EPA funded Pollution Identification and Correction (PIC) program was organized to coordinate actions to reduce fecal coliform and keep shellfish beds open.

We have a serious pollution problem in the Samish watershed that continues to threaten our livelihood, recreation, shellfish beds and quality of life. We have had a good program in place, but we welcome the extra help and added manpower to address this issue.

– Ron Wesen, Skagit County Commissioner

GOAL

- Upgrade the status of shellfish beds in Samish Bay from “Conditionally Approved” to “Approved”, eliminating the need for shellfish bed closures due to fecal coliform bacteria.

The current classification of Samish Bay requires a precautionary closure of shellfish harvesting when flow in the Samish River rises above certain criteria because the risk of fecal contamination in the runoff is too high. The closure is considered “confirmed” if subsequent laboratory analysis of water samples confirm that the fecal coliform loading rate exceeds the number established by the Department of Health for protection of the Samish Bay. Loading rates are related to the state water quality criteria for fecal coliform. Closures are temporary until subsequent laboratory results can confirm that fecal coliform bacteria are within state allowed levels.

In order to upgrade Samish Bay shellfish beds, closures need to be limited to no more than one closure during the critical period for high bacterial loading which is from March–June during high precipitation events. Samish Basin recently failed a four-month Department of Health water quality evaluation in the third week of 2014.

ACTIONS

Several actions were taken to reduce fecal bacteria in Samish Basin that included identifying sources, working with landowners, and correcting problems (Table 1).

DESIGNATE SAMISH BASIN AS A MARINE RECOVERY AREA (MRA)

The entire Samish Basin was designated as an MRA to address on-site sewage system contamination and ensure systems are compliant with state law (RCW 70.118A.040). Most of the Samish Watershed was already declared an MRA in 2007, and work was currently in place assuring septic systems were inspected. The 2007 MRAs included the sub-basins for Colony Creek, Thomas Creek, the Upper Samish (including Friday Creek), the Lower Samish and Samish Island. Two additional MRAs were added in 2012 (Upper NE Samish and Willard Creek) to encompass all the waters in the Samish River Watershed.

ESTABLISH CLEAN SAMISH INITIATIVE

In 2009 the Department of Ecology facilitated the collaboration of over 20 local, federal, state, and non-governmental stakeholder organizations to develop a work plan to reduce fecal contamination by implementing education and outreach, sampling water quality, referring landowners to resource agencies for pollution abatement, and enforcing water quality and land use regulations. This initiative leveraged EPA funding to implement clean-up actions.

POLLUTION IDENTIFICATION AND CORRECTION (PIC) PROGRAM

The PIC program works with stakeholders and community members to assess properties, provide resources to landowners to make repairs, and monitor water quality to detect problems and areas to focus contact with landowners. Parcels were evaluated with drive-by surveys and aerial imagery in agricultural areas. Skagit County Public Works and WA Department of Ecology staff followed up with farm visits and site inspections if an initial evaluation indicated a potential source of bacterial contamination. Skagit County Public Health inspected septic systems. Skagit County Planning and

Development Services followed up with violations and enforcement actions related to the Critical Areas Ordinance. In a few cases, the Department of Ecology worked with local agencies to support enforcement of pollution regulations. The Skagit Conservation District provided farm plans to landowners for manure storage, drainage solutions (e.g., roof gutters), and agricultural best management practices (BMPs).

- As of 2014, 100% of 6,330 parcels were evaluated; of these, 100% of 5,450 non-timber parcels have been assessed. All parcels that need to be inspected have been. PIC inspectors provided free technical assistance to guide property owners through the process of correcting identified pollution sources, such as failing on-site septic systems, pet waste, livestock and agricultural animal manure, failing sewer infrastructure, and correcting illicit discharges to storm water and storm water conveyances.
- For septic systems, 47% of the inspections are currently up-to-date; these numbers change daily as property owners update their inspections. Gravity systems are required to be inspected every three years. All other types of systems are to be inspected annually.
- As of March 2013, only 3% of the 4,253 on-site septic systems that were inspected needed repairs, another 2% were failing and needed further repair or replacement.
- Provided assistance in the implementation of 100 structural BMP's.
- The Conservation District provided farm planning and technical assistance to 53 landowners, 174 farm visits, and completed farm plans for 53 landowners with recommendations for best management practices to minimize fecal contamination.
- A total of 22,905 linear feet of fencing, approximately 14,000 native riparian plants, 91 pieces of large woody debris for bank stability and increased channel complexity, and a bridge were installed; and 30 acres of riparian habitat were improved (Table 3).

Table 1. Program, actions, outcomes, challenges and total cost to reduce fecal coliform and protect shellfish beds in the Samish Basin watershed. Program costs for Samish Basin were calculated for 1/1/2010 – 7/31/2014, a period of 4.5 years.

Program	Actions	Results	Challenges	Total Cost
Pollution ID and Correction	<ul style="list-style-type: none"> - 6,330 parcels evaluated - 53 farm plans implemented - Used molecular source tracking to identify fecal sources 	<ul style="list-style-type: none"> - Pollution caused by fecal coliform bacteria decreased annually at most sites - Shellfish beds were closed fewer days - Water is cleaner - 100 best management practices implemented - 	<ul style="list-style-type: none"> - Levels of fecal coliform bacteria still exceed state standards at many sites - Shellfish beds are still closing - Livestock move between inspections - Difficult to interpret molecular source tracking data 	\$1,700,000
On-site Septic Systems	<ul style="list-style-type: none"> - 4,253 septic systems assessed - 500 people took septic system classes (Skagit County) 	<ul style="list-style-type: none"> - 95% passed - 3% needed repairs - 2% failed 	<ul style="list-style-type: none"> - Owners need help with expensive repairs - Continued inspections necessary 	\$2,806,000
Natural Resources Stewardship Program	<ul style="list-style-type: none"> - Farms with livestock inspected - 22,905 linear ft of fencing installed to keep manure out of streams 	<ul style="list-style-type: none"> - 30 acres of habitat upgraded - 17 landowners enrolled in program 	<ul style="list-style-type: none"> - Fencing keeps cows out of streams, but manure stills runs into streams during extreme rainfall events 	\$472,000
Regulatory and Enforcement	<ul style="list-style-type: none"> - Enforcement actions taken on a few parcels - Worked with individuals to increase compliance 	<ul style="list-style-type: none"> - Overall compliance increased - 4 out of 6 parcels in violation improved 	<ul style="list-style-type: none"> - Regulatory enforcement is sometimes necessary when voluntary actions are not sufficient 	\$174,000

Table 2. Recovery and management actions in the Samish watershed through 2013 (Skagit County Public Works Natural Resources).

Action	Results
Assess 6,330 parcels (5,450 are non-timber)	100% have been assessed
Inspect 4,253 On-site sewage (OSS) systems	47% of inspections are currently up-to-date
Evaluate OSS failures (2013)	2% need repair/replacement
Follow up with site inspections	150 site-visits
Develop Conservation District farm plans	53 implemented
Implement Best Management Practices (BMPs)	100 implemented
Install pet waste stations	16 locations
Install portable toilets	12 installed

Table 3. Recovery and management actions of the Natural Resources Stewardship Program in the Samish Basin watershed through 2013.

Action	Results
Implement Projects	17
Number of land owners enrolled in NSRP	17 participants
Fence livestock out of streams	22,905 linear feet installed
Improve natural habitat	91 pieces of large woody debris installed
Livestock crossings	1 installed
Improve riparian buffer habitat	20,000 linear feet
Enhance natural habitat	30 acres improved
Restore native vegetation	14,000 plants installed

Table 4. Farm visits, farm plans, and parcels evaluated by year.

Year	Farm Visits	Farm Plans Produced	Parcels Evaluated (n =5450)
2009	17	22	22
2010	28	23	30
2011	61	17	462
2012	45	10	2351
2013	23	3	1642
Total	174	75	4507

COMMUNITY EDUCATION & OUTREACH

The Skagit Conservation District led implementation of a landowner outreach program that provided educational forums and materials to livestock owners to gain support for agricultural best management practices.

Protocols were developed to provide inspection information, work plans, and establish agency contacts for landowners. Communication tools were aimed to clarify landowner obligations, expectations and outcomes of inspections, and explained the regulations aimed at protecting the watershed from fecal contamination.

Community outreach regarding fencing and best land management practices was implemented under Skagit Conservation District and County Natural Resources Stewardship programs to help prevent livestock from entering or contaminating local streams and tributaries that flow to the Samish River.

- Septic system maintenance classes hosted by Skagit County had approximately 500 participants County-wide. Samish Bay watershed residents were not counted separately, however most septic system class participants are spurred to take the class because of outreach efforts. The majority of participants were likely from the Samish Watershed.
- The Clean Samish News publication distributed to over 6,000 watershed residents.
- Educational displays hosted at a variety of educational events.
- One-on-one support provided to the Friday Creek Habitat Stewards and numerous community residents.

REGULATORY COMPLIANCE

Increased involvement from partnering agencies worked to increase compliance with water quality laws. Enforcement actions, including warnings, orders and penalties were taken to ensure compliance. Actions taken to identify priority parcels included:

- Inspect all parcels to evaluate fecal coliform loading contribution into Samish Basin consistent with state law (RCW 70.118A.040), identify high priority areas to focus clean-up efforts, and explore options to reduce bacterial contamination.
- Skagit County: expedited the property inspection efforts in the Basin.
- Department of Agriculture: increased site visits of small acreage and animal operations, and continued inspection of seven dairies in the Samish Basin.
- Department of Ecology: expanded inspection capacity to properties that create, store, or apply manure.
- Regulatory enforcement action was taken on a few non-compliant parcels.

MICROBIAL SOURCE TRACKING

Water samples were collected and the fecal contamination was evaluated to determine the source. Two molecular source tracking studies, one by the EPA and one by Oregon State University, were completed to identify sources of fecal contaminants in Samish Bay. Molecular markers were used to determine whether the sources could be traced to humans, ruminants, horses, gulls, or dogs. Results showed the highest rate of appearance for ruminant and avian sources, but data interpretation was hampered by poor blind-sample performance and lack of correlation between microbial marker counts and fecal coliform counts.

OUTCOMES

- When the Clean Samish Initiative began, over 80% of river rises resulted in confirmed shellfish bed closures due to high levels of fecal bacteria. By the end of the 2013, that percentage dropped to approximately 50%. During the first half of 2014, the percentage was 47%.
- Since 2010, fecal contamination during storms, when fecal coliform loads are the highest, has steadily declined for all sites. At the most downstream site, Samish River at Thomas Road, fecal coliform has decreased by >80% (Figure 1).
- The percentage of times that fecal coliform values have exceeded state water quality standards has declined significantly across all sites since 2006 (Figure 2).
- The commitment of local government and executive committee members increased watershed resident participation in clean-up efforts.
- The number of landowners participating in voluntary programs has steadily increased.
- Results from molecular source tracking study indicated ruminant, avian, and human sources of contamination. The OSU study suggested ruminants were the leading source, followed closely by avian sources. However, the quantification of markers did not correspond well with fecal coliform counts from the same samples, and some blind quality control samples were not accurately identified. MST results served as a general indicator of fecal coliform sources and education tool, but the science is not developed to the point where accurate results can be determined from individual samples.
- As a result of regulatory actions, 4 out of 6 landowners complied with legal requirements.

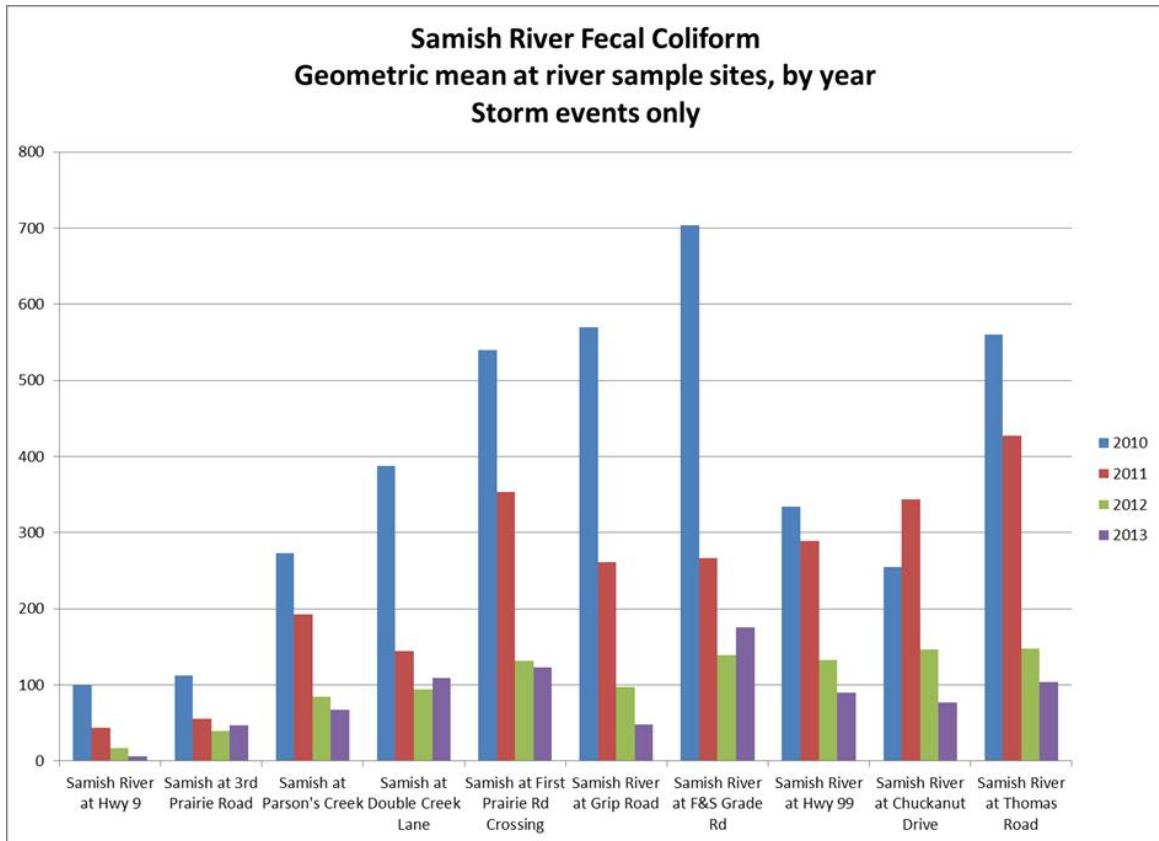


Figure 1. Fecal coliform bacteria declined at every site from 2010 to 2013. Shown are geomean values of fecal bacteria measured after storm events when pollution is highest. For each site, bacteria are shown for each year.

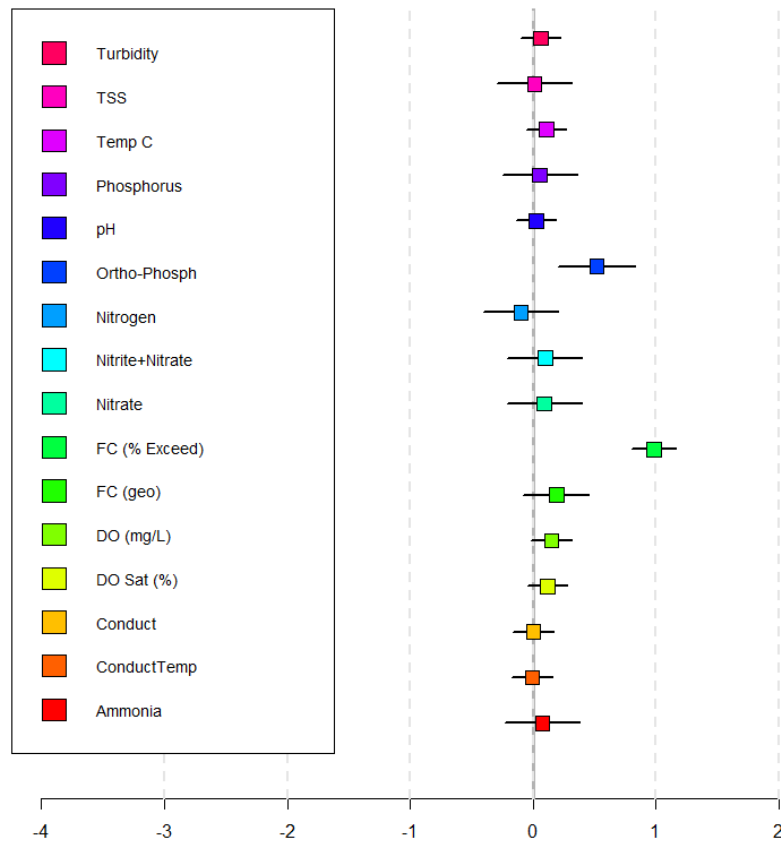


Figure 2. Change statistics for water quality measures. Values greater than zero indicate an improvement in condition (i.e., a decline in fecal coliform exceedences). Values less than zero indicate a decline in water quality measure. Box values represent Cohen's d, which summarizes change over time at 11 sites in the Samish watershed from 2006 to 2012; whiskers represent the 90% confidence interval. (See Appendix 1 this document for a description of meta-analysis methods.) Exceedances for fecal coliform and ortho-phosphate levels improved over time, indicated by the positive values for Cohen's d. FC = fecal coliform (geo = geomean; % exceed = fecal coliform samples that exceed state criteria); TSS = total suspended solids; Temp C = temperature (C°); DO = dissolved oxygen; Conduct = conductivity; ConductTemp = specific conductance (C°).

CHALLENGES

- Fecal coliform exceedances at monitoring sites are significantly decreasing, yet levels of fecal coliform bacteria still exceed state water quality standards at many sites.
- Shellfish beds in Samish Bay are still subject to frequent closures, especially during high rainfall.
- Livestock tend to move between inspections.
- Continued inspections are necessary for septic systems and farm parcels.
- Fencing livestock out of the stream does not prevent manure from contaminating the stream during the highest rainfall events.
- Regulatory enforcement is sometimes necessary when voluntary compliance does not resolve the problem.
- Molecular source tracking results vary from testing laboratories and are difficult to interpret in terms of which sources are the largest contributors to fecal contamination.

COSTS

Program costs for Samish Basin were calculated for 1/1/2010 – 7/31/2014 a period of 4.5 years. Costs are from Skagit County Public Works, Planning and Development Services, and Public Health and Community Services. Funding was a mix of state and federal grants and match from the County.

Program	Total Cost	% of Total
On-site Septic Systems	\$ 2,805,876.00	40%
Natural Resources Stewardship Program	\$ 471,773.00	7%
Pollution ID and Correction	\$ 1,700,000.00	24%
Clean Water Law	\$ 174,208.00	2.5%
Clean Water Partners	\$ 1,113,394.00	16%
Administration	\$ 715,724.69	10%
Pet Waste Stations & Port-A-Potties	\$ 8,750.00	0.1%
Grand Total To Date	\$ 6,989,725.69	100%
Total County Expenditures in Samish Basin	\$1,992,486.04	28.5%
State and Federal Grants	\$ 4,997,239.65	71.5%

INSIGHTS FROM SAMISH BASIN

- One-on-one communication with landowners is key to compliance, small changes at the parcel scale add up to large reductions in fecal contamination.
- Fecal contamination increases dramatically after storm events suggesting that surface water run-off moves manure from farms and fields into streams.
- High soil moisture may cause septic systems to inadequately treat effluent.
- Waterfowl are most likely not a major source of contamination during the critical late spring period because they migrate away from the Samish watershed before fecal coliform counts and loadings peak during the late spring.
- Skagit Stream Team (a volunteer group) provided critical data that elucidated the relationship between high precipitation events, freshwater quality, and the quality of marine receiving waters. Their work also helped open shellfish beds faster when storm events happened outside normal business hours.
- Fencing out livestock from streams and tributaries keeps the livestock out of the watershed, but fecal contamination can still occur due to the proximity of the animal waste to water, especially during the most intense rain events.
- Manure spreading during the wet season increases the chance of fecal contamination due to run-off and because the ground is saturated.

- Regulatory actions are needed in some instances, but are best used sparingly. When regulatory actions are used, they are best coordinated with all regulatory agencies participating in the larger clean-up effort to avoid loss of trust within the community.
- Fixed monitoring sites are useful in tracking progress and if enough are monitored, they can be used to characterize the overall condition of the watershed.
- Now that all parcels have been inspected, the rate of discovery of new problems has slowed down. Recovery efforts can now focus on known problems and repairs.

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